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# UTILIZATION OF STRAW IN FURNITURE DESIGN

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## ABSTRACT

Waste straw from rice harvesting in Indonesia, especially in the city of Solo and its surroundings, is very abundant and has not been utilized optimally yet. This is an economic potential if it is developed with furniture products which are the leading export products in the city. The purpose of this creation is (1) Utilization of straw rope as a material for supporting application in making furniture (2) Furniture products using wood and straw applications. To achieve the goal, it takes steps or methods of creating works by utilizing emic and ethical data, including: experimentation, contemplation, and formation. From the creative process, it produces: (1) quality straw gyres and is suitable for use as supporting applications in furniture products, (2) Furniture products with wood and straw rope applications that are tested and feasible to produce.

**Keywords**: Straw, waste, rope, and furniture

## *ABSTRAK*

*Jerami limbah dari panen padi di Indonesia, khususnya kota Solo dan sekitarnya, sangat berlimpah dan belum termanfaatkan secara optimal. Hal itu merupakan potensi ekonomi jika dikembangkan dengan produk mebel yang merupakan produk unggulan ekspor di kota tersebut. Tujuan penciptaan ini adalah (1) Pemanfaatan jerami menjadi bahan pilin sebagai aplikasi pendukung pembuatan mebel (2) Produk mebel dengan aplikasi kayu dan pilin jerami. Untuk mencapai tujuan dibutuhkan langkah-langkah atau metode penciptaan karya dengan memanfaatkan data emik maupun etik, meliputi: eksperimen, perenungan dan pembentukan. Dari proses kreatif, menghasilkan: (1) Pilin jerami yang berkualitas dan layak digunakan sebagai aplikasi pendukung pada produk mebel, (2) Produk mebel dengan aplikasi kayu dan pilin jerami yang teruji dan layak diproduksi.*

***Kata kunci**: Jerami, limbah, pilin, dan mebel*

## 1. Introduction

In Indonesia, the straw produced by farmers is very large, reaching 64-96 million tons / year, with a calculation that on average every 1 kg of rice produces about 1 - 1.5 kg of straw. Indonesia even ranks third as the third largest rice

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producing country in the world with 64 million metric tons/year. Straw by most of the farmers is still considered as residual waste from harvesting, and generally burned and partially used for various purposes. As much as 62% of the burned straw, 38% is used as animal feed or for industrial purposes.

The rice plant as a producer of rice is the most widely planted crop by the people of Indonesia. Plowing, planting, nursing, and harvesting and so on as a cycle is a routine carried out by rice farmers. Harvesting is an effort to harvest crops by cutting and threshing rice into grains. Rice stalks that have been threshed with grains of rice are called straw. Rice stalks or straw for most Indonesian people are generally still categorized as harvesting waste. In fact, straw is only burned by most of the farming community.

Straw as waste from rice harvesting is abundant in very big volume and has not been used optimally. Therefore, its utilization becomes important in order to provide added value and increase the economy of farmers. Referring to the characteristics of the elongated and fibrous straw, it is possible to use it as a raw material for handicraft and furniture products.

The use of straw for industrial purposes includes fertilizer, animal feed, and handicraft industry. The straw-based handicraft industries include paper, mats, paintings, sandals, bracelets, necklaces, puppets, chicken or bird nests, egg packing, furniture and so on. The common production techniques for these various handicraft products are weaving, twisting, tying, rolling, *kempa*, cutting and pasting, and paper with fibers. Indonesia's creative industry products in the global market, especially handicrafts and furniture, their strength or competitiveness is in the very varied raw materials (Hidayat, 2011).

Natural fiber materials that are quite popular for the benefit of the handicraft and furniture industry include pineapple fiber, *rami* fiber, water hyacinth (*eceng gondok)*, and *mendong*. In some types of those materials, of course, have differences in characters, colors and strengths. The nature and characteristics of natural fibers for handicraft and furniture products, their use and placement will of course also be

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different. Therefore, this research is how to use straw fiber as a material for the handicraft and furniture industry. The aims of this study were: (1) Utilization of straw rope as a material for supporting application in making furniture (2) Furniture products using wood and straw rope applications.

## 2. Literature Review

Basically, many efforts have been made to utilize straw, including as pulp, where straw is combined with sodium hydroxide (Jalaluddin, 2005), straw as particle board (Gultom, Dirhamsyah, & Setyawati, 2013), and straw as acoustic panel (Mediastika, 2007). Utilization of straw stem directly with what they are as handicraft products (Rubiyar, 2006) in the form of flowers, wall decorations, pencil cases, photo frames, and so on. The technique of working is arranged directly, and even into products ranging from bags, shoes, tissue boxes, frames, brooms and so on. Utilization of straw for handicraft products in general is directly into the finished product of handicrafts, and has not been in the form of raw materials or semi-finished products.

In addition, processing of straw into art paper is by cooking, washing, grinding, printing, making motifs and drying to become sheets of paper for craft products (Lopes, 2013). Straw as organic fertilizer is processed by chopping it, spraying it with water and stirring it, and putting it in a box, then the straw that is ready to be decomposed is covered with plastic to make a decomposer solution and water, stirred until smooth and carried out for several weeks (Sitepu, Anas, & Djuniwati, 2017). Processing of straw and bunches of palm oil can produces bioethanol (Ulya, 2011).

The state of the art of this research lies in the utilization of straw by grinding it, so that it is possible to mass produce both in the form of semi-finished materials and finished products through processes with certain Appropriate Technology *(Teknologi Tepat Guna)*. The milled straw fibers are then turned into pliable and flexible straw fibers, making it possible to work the straw fibers by twisting, weaving and stacking over each other.

Straw as a raw material for handicraft and furniture products, raw materials are available in abundance in many regions. Central Bureau of Statistics (Badan Pusat Statistik) data shows that the agricultural sector in Indonesia in 2017 as of May there were 39.68 people or around 31.86% with an area of 7,876,565 hectares. Using an estimated harvest index of 0.5 per hectare of rice crop harvests 3 tons of dry straw can be produced according to Paavilainen and Torgilson (1999). The availability of rice straw in Indonesia is more than 55 million metric tons a year. Of that amount, only a few are used, because most of it is burned after the harvesting process. Estimates of unused rice straw are around 60% (Anonymous, 2003).

Rice is included in the family of grains (Paoceae), kingdom plantae, division magnoliophyta, order poales, family paocea, genus oryza, species O sativa. The physical characteristics of rice plants are carved fibers and lanceolate-shaped leaves. Rice is cultivated as a main food by the people of Indonesia, therefore the amount is extraordinary. Some of the nature and characteristics of the straw can basically be used for several human purposes, including for handicraft products.

The inspiration that straw fiber can be used as raw material for handicraft products was accidentally when found a pile of straw on the side of the road that was run over by a vehicle. Trash that is run over by vehicles produces straw fibers. The temporary assumption is that straw can be further processed into straw fiber as a material for handicrafts and furniture.

Straw as a raw material for handicraft and furniture products uses two and three-dimensional product design principles which are summarized in Nirmana's science. The basis of a *Dwimatra* or two-dimensional design includes shape, repetition, *racana*, similarity, *roncetan, pancaran, kelainan, kecengkahan,* density, *barik* and space. Two and three-dimensional design principles include color values and tones; shape, size, direction and texture; rhyme, rhythm, harmony; unity; domination, suppression; balance; proportion; simplicity and clarity.

## 3. Creation Methodology

The method used refers to the "process of artistic creation" by utilizing emic

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and ethical data, which are data used by artists in the artistic creative process, including experiment, contemplation, and formation (art structure) (Dharsono, 2016).

1). Experiment

Experiments are steps of activities carried out by artists and/or designers in carrying out the steps of the artistic creation process (creation), which include: (1) trying several alternative materials that are appropriate and suitable for the designed artistic expression, (2) trying several alternative individual techniques that match the expression in the designed artistic creation, (3) trying several alternative tools that match the expression in the designed of art creation, and (4) the selection of visual concepts (layout).

Experiments will produce quality in the selection of materials, techniques, tools and layout concepts that will be used by artists in visualizing their designs. Academic artists have the possibility of discovering the concept of the experiments carried out. Therefore, creative experiments in collaboration with laboratories will produce various alternatives that are needed by artists. Artists choose what is appropriate and able to assist artists in expressing their feelings individually.

2). Contemplation

Contemplation is the artist's inner explore in search of symbols (metaphors). Contemplation is carried out to seek and find symbols (metaphoric language) that will become icons in the artistic creative process in the creation of artworks. In contemplation, the artist and/or designer will come across or find symbols and/or metaphors. The symbol will be used as the language of expression, and then it will be used as the main motif, supporting motif and filling motif. The main motive will be the center of interest and which will become a communication idiom that is realized through the media and becomes a personal expression. The main motive is a metaphorical idiom that provides philosophical information that is very individual in nature. However, metaphorical idioms will invite interpretation, and multiple interpretations in the life process. Though sometimes metaphorical idioms are not the result of contemplation, but are the result of natural interpretation that has

undergone a process of imagination. Sometimes metaphorical idioms are symbols or motifs borrowed from traditional idioms or artifacts that are chosen as symbols of expression. However, there are times when metaphorical idioms are a symbol language that has become a community agreement. The presentation of metaphors in art is an idiom that is present as a communication between the artist and audiences, although it is very personal in nature, and invites interpretation.

Metaphors (symbols) as personal expressions will be bound by the principles and basics of the layout and the formation of works of art creation and/or design of works designed in the aesthetics of the forms presented.

3). Formation

Formation is a layout design or composition designed to get the form or structure of the work. Structure is a composition that will always be related to (1) the quality of the elements as designed art icons, (2) the principles of layout (harmony, contrast, rhythm (repetition), gradation) that are designed, (3) the principles of layout include balance (formal/informal) designed to achieve unity. The layout will produce dynamics (soft, medium, and strong), and these dynamics will produce a certain atmosphere and/or a certain impression.

## 4. Discussion

### 4.1. Creative Process

Straw fiber through certain treatments can be processed by twisting, braiding, and weaving. The criteria for selecting straw to be twisted as a material for handicraft and furniture products are rice plants with large diameter, height, and tenacity. Straw leaves cleaned until the remaining rice stalks without leaves. The rice stalks are then twisted into elongated threads. The twisted stems or rice threads are then made into several sizes with different diameters. The results of the straw rope are then used as the basis for the design and development of handicraft and furniture products. In Surakarta area and its surroundings, the types/varieties of rice that are widely planted by farmers include IR 64, *slegreng*, *cieherang*, etc. In this study, the type of straw selected was upland *(gogo)* red rice straw, *slegreng* variety. The main

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selection is based on tenacity compared to other straws.

The selection of cut straw is straw that is cut manually. Manual cutting consists of two kinds. Manual cutting for irrigated land and tidal land is done by cutting the neck of the stem, so that the remaining straw or rice stalks are short. Manual cutting for irrigated area is carried out from the bottom to near the tree roots. This method produces straw or long stalks of rice. Therefore, straw was selected for the type/variety of *slegreng* that was cut manually.

Utilization of straw as a craft product material is to be twisted to produce straw thread. The use of straw that needs to be avoided is a brittle material. Therefore, the straw is twisted when it is not completely dry, that is, it is dried in the sun two days after cutting. The straw fiber used is in the stem. Rice leaves are brittle, so the rice leaves are not used. This is done to produce a strong straw fiber. Cleaning is done using a rake to make it easier to remove straw leaves.

**Figure 1.** (a) semi-dried straw that has not been cleaned; (b) semi-dried straw after cleaning the leaves (Photo: Sumarno 2019)

The anatomy of rice stalks consists of roots, stems, leaves, and grains. Rice as a Gramineae family, therefore the rice stems are hollow and segmented. Straw segments are hard, and break easily. In order to produce a rope of straw, therefore, the straw segments need to be broken down, namely by grinding.

The next process is twisting the straw. In this study, the twisting was done manually. Twisting can be done on each straw bar connected so that it becomes long.

Utilization of straw is tried to be several more components, therefore twisting it into several alternatives with different diameter sizes and lengths as needed. The diameter sizes made are 2 mm, 4 mm, 6 mm, 8 mm, 10 mm and 12 mm.

**Figure 2.** Large and small straw ropes
(Photo: Arthea 2019)

| EXPERIMENT | | |
|---|---|---|
|  |  |  |
| Soaked in water for 3 hours | Soaked in water for 6 hours | Soaked in water for 12 hours |
|  |  |  |
| Soaked with star fruit (blimbing wuluh) water for 3 hours | Soaked with star fruit (blimbing wuluh) water for 6 hours | Soaked with star fruit (blimbing wuluh) water for 12 hours |
|  |  |  |
| Soaked with orange water for 3 hours | Soaked with orange water for 6 hours | Soaked with orange water for 12 hours |

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| | | |
|---|---|---|
|  |  |  |
| Soak in vinegar water for 3 hours | Soak in vinegar water for 6 hours | Soak in vinegar water for 12 hours |

**Figure 3.** Straw rope with several soaking experiments before twisting
(Photo: Arthea, 2019)

Rice has 25 species of Oryza, of which Oryza sativa is known, with two main species, japonica (feather rice) and indica (cere rice). Japonica rice is widely grown in subtropical areas, while indica is widely grown in Indonesia (Purwono & Purnamawati, 2009). Now in Indonesia there are various types of rice plant varieties where each variety has a different character. This research was conducted in Central Java, especially Solo and its surroundings, so that experiments and efforts to utilize straw focus on the varieties found in Solo and its surroundings.

Rice varieties that are widely planted in the Solo and surrounding areas include lowland rice *(padi sawah)* which includes IR 64, *membramo*, *ciherang*, *inpari*. Meanwhile, upland rice *(padi gogo)* includes *bagendit* and *slegreng*. Based on the plant height of the six rice varieties above, membramo is the tallest, which is between 126 - 140 cm (Suprihatno et al., 2009). Based on the tenacity of the stem, slegreng is the most resilient or elastic.

*Slegreng* is an upland variety of red rice. This rice is widely planted in Solo and its surroundings, because the Solo and surrounding areas tend to be dry or tidal. Slegreng red rice has advantages, namely (a) The yield is quite high 3-4 tons/ha; (b) the color of red rice on the husk contains β-carotene 488, 65 micro g/ 100 g, can function to maintain heart health and prevent aging; (c) High selling value of rice, 30% more expensive than ordinary rice; (d) rice that is tolerant to water stress; and (e) high protein content which is about 7.3%, iron 4.2%, and vitamin B1 0.34% (Kristamtini & Purwaningsih, 2009). Straw is abundant as harvesting waste with

very low economic value. Slegreng is widely planted by Solo farmers, because it is more resistant to water that is somewhat limited.

The weakness of the straw in the twisting process is that the rice segments are brittle, this condition requires special treatment so that: (a) the straw or straw segments become more flexible/elastic, so it is necessary to have a tool that can perfect/maximize the product of the straw fibers; (c) twisting requires a special tool design. The problem with straw is the brittle nature of the straw, so maximum twisting is recommended.

Twisted straw rope has no strength, therefore it is necessary to make several sizes with different designations. Large diameter rope is recommended due to the low strength of the straw. With a large diameter it is possible to be stronger. Referring to the nature, character, color and strength of rope, its use also needs to be considered related to the placement of the product, inside or outside the house.

The hairy (not fibrous) straw stalks can make human skin itchy. The level of smoothness is not softer than *mendong* and water hyacinth *(eceng gondok)*. So that the straw needs surface coating with wood glue. The wood glue not only has the function of covering the hair/feathers, it also increases the strength of the straw stems.

Straw rope have limited shape and strength, so that in the design they are not possible to be used as main structures. Straw rope in furniture design can serve as a supporting element (decoration). Straw rope can be used for the manufacture of furniture products through woven techniques, because the woven can make the ropes interlock and tie together so as to create strength as a functional component.

Utilization of woven straw rope in furniture design, among others, is as woven on the seat, back and cover of the furniture frame. The woven straw rope in furniture products needs to pay attention to its aesthetics, namely the woven pattern. The principle of balance, contrast and straw twist is applied to straw rope with various diameters and lengths. The arrangement can be done either by woven, pasted, or twisted. The pattern of woven ropes made from mendong, water hyacinth, and rattan

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can basically be applied to straw ropes.

### 4.2. Artwork

The manufacture of furniture with the application of straw rope, is designed in such a way that the straw rope is not only a supporting element, but also as an aesthetic support element. The combination of wood as main structure with yellowish straw rope can create a quite interesting composition.

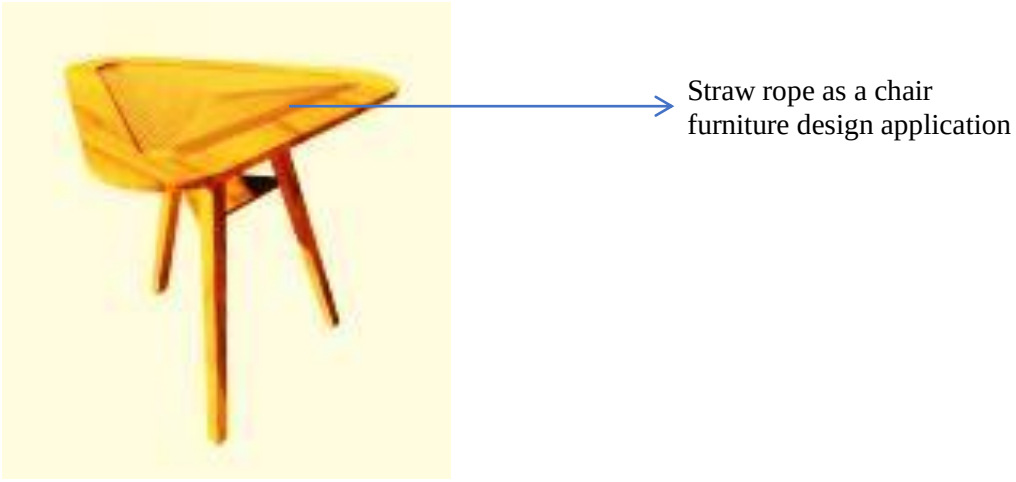


**Figure 4.** Chair furniture with wood and straw rope applications
(Designer: Sumarno, 2020)

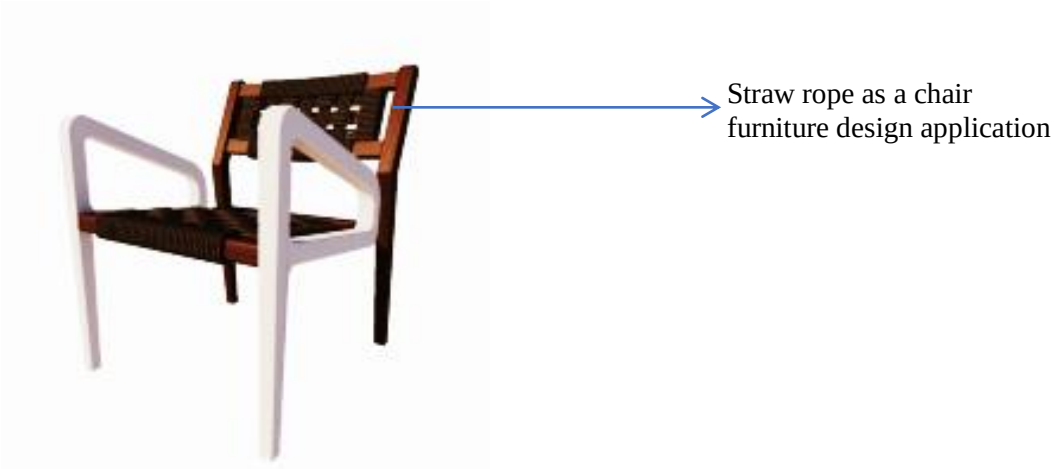


**Figure 4.** Chair furniture with wood and straw rope applications
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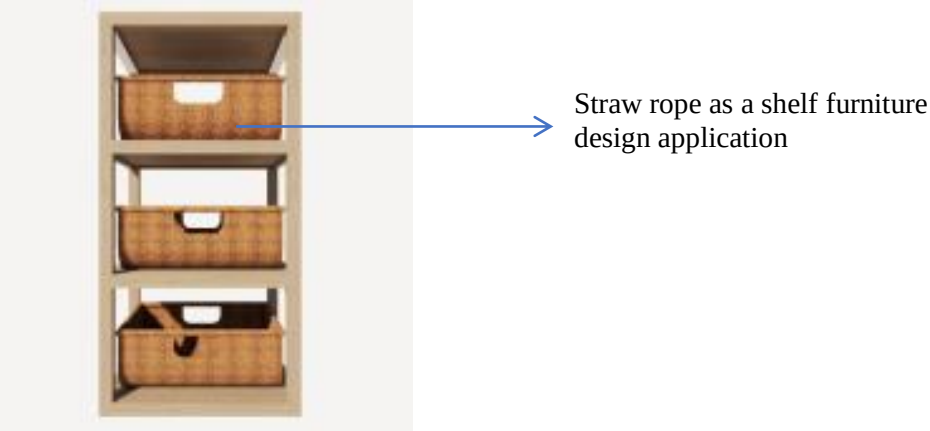


**Figure 6.** Shelf furniture with wood and straw rope applications
(Designer: Sumarno, 2020)

The three prototypes of the furniture products above have been tested for feasibility through the Testing and Calibration Laboratory of the BBTPPI Semarang which is under the Balai Besar Teknologi Pencemaran Industri, Badan Penelitian dan Pengembangan Industri, Kementerian Perindustrian RI, (Center for Industrial Pollution Technology, the Agency for Industrial Research and Development, the Indonesian Ministry of Industry,). The results of the feasibility test with the number: NoSei: 014607/ 3426.2020/AK2.0519. December 2, 2020.

## 5. Conclusion

The abundant straw waste in Solo and its surroundings has high economic potential if it is used to support furniture products, especially since this area is a producer of furniture exports abroad. The utilization of straw waste is carried out through the process of selecting the type of rice and processing on the right rice stalks to become straw rope.

Utilization of straw waste into straw woven rope/thread which is then applied to furniture design can produce artistic, attractive, and feasible prototypes of wooden furniture to be produced. The use of woven techniques in the application of straw rope into wooden furniture can provide aesthetic value. The feasibility of furniture design with the application of straw rope has also been tested through standardized testing and calibration for export to Europe.

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